Space Weather Technical Forecast

Issued on Thursday 16 January 2025 at 01:01 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Increasing chance of isolated M-class flares. Solar winds generally elevated.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low with the peak flare a C6.3 at 15/0856 UTC from AR3961 in the southeast. There are currently six sunspot regions, with the small AR3963 numbered. The largest is AR3959 in the northeast, comprised of a large leader spot with a much smaller trailer region. AR3961 in the southeast has shown some growth in its intermediate spots but is otherwise a relatively simple bipolar group. The other regions are currently smaller and simpler, however AR3962 has the potential for more complexity to become evident as this moves further onto the Earth-facing disc.

No Earth-bound CMEs were observed in available imagery.

Solar Wind / Geomagnetic Activity: Ongoing fast wind influence was observed. Solar wind speeds were mainly elevated, between 450-500 km/s, with brief peaks towards 550km/s. Density was average to below average. The Interplanetary Magnetic Field, Bt, was Weak to Moderate, ranging 4-9nT. The north-south component, Bz, was Weak, ranging between +/- 7nT. Phi angle was generally negative (towards the Sun). Geomagnetic activity was Quiet to Unsettled (Kp2-3) with two Active (Kp4) intervals 15/0300-0900 UTC.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) at GOES-18 was Background. High energy electron flux (greater than 2MeV) at GOES16 was Background to Moderate with the associated 24 hour fluence below the Active threshold. This reached 1.36e7 integrated pfu at 16/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate with an increasing chance of isolated M-class flares.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs currently forecast. Ongoing coronal hole influence is expected, with a transition from the fast wind of CH08/- to CH09/-, this then likely persisting for much of the period. Slightly elevated to elevated solar winds forecast, perhaps peaking days 2-3 (17-18 Jan). Mainly Quiet to Unsettled geomagnetic activity is expected with a chance of Active intervals on all days. There is a slight chance of reaching a G1 Minor Storm interval, perhaps slightly higher days 2-3 (17-18 Jan).

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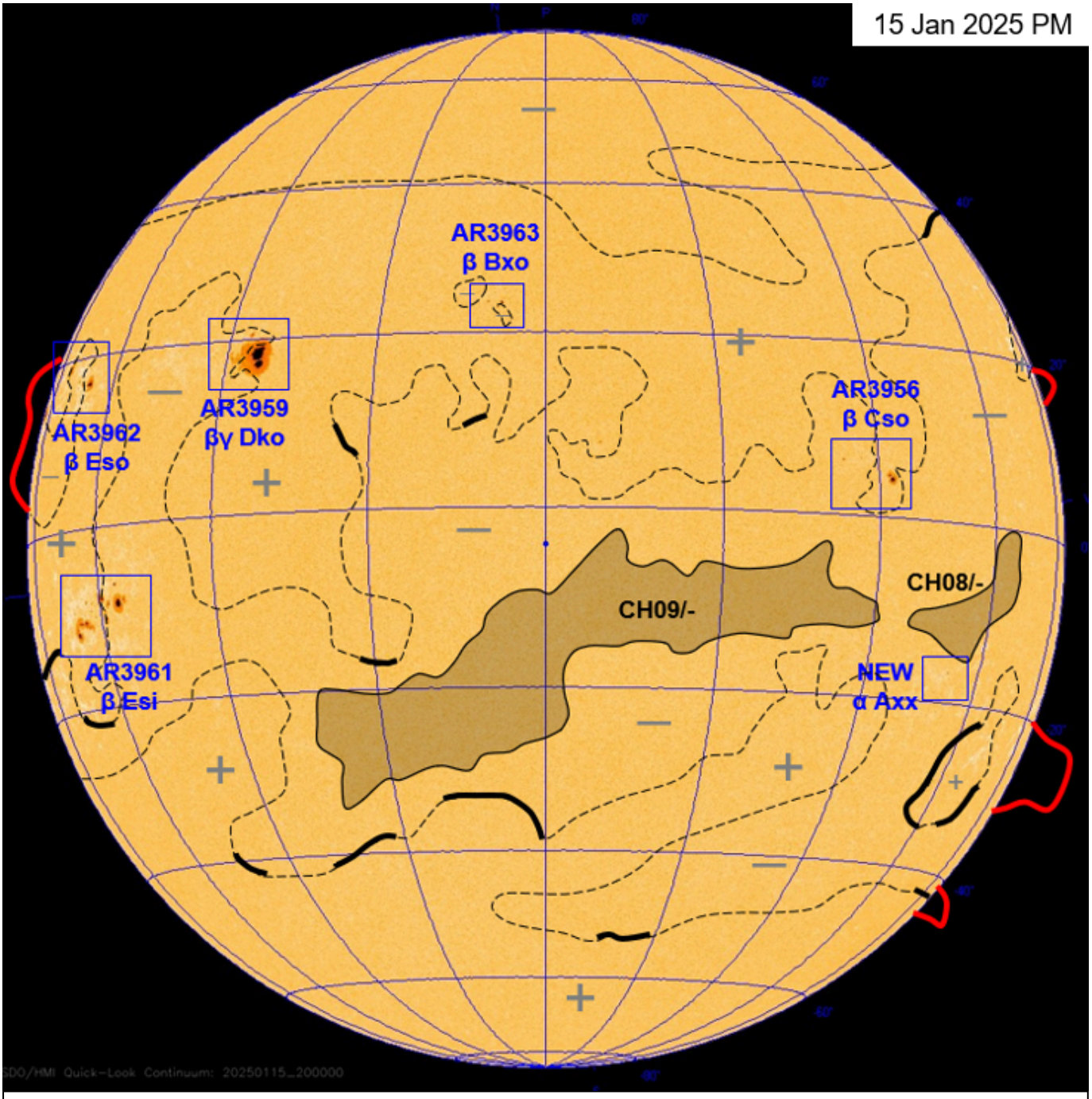
Energetic Particles / Solar Radiation: GOES18 high energy proton flux is expected to remain at background. GOES-16 high-energy electron flux is anticipated to be at background with diurnal Moderate peaks, perhaps rising to High at times. The associated 24 hr fluence is expected to persist below Active (1e8 integrated pfu) levels however.

Figure 1: Solar Synoptic Map valid 15/2000UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

There are no Earth-directed CMEs currently forecast.

The solar wind outlook is dominated by the broad coronal hole across the central southern disc, CH09/-, connection to this feature is likely to follow on from the ongoing enhancement from CH08/- which is now becoming harder to observe on the western disc, perhaps as early as day 1 (16 Jan). Due to this extended feature ongoing fast wind influence is likely through the period, with slightly elevated (400-500km/s) solar winds expected, likely strengthening to be elevated (500-600km/s) at times, particularly perhaps through days 2-3 (17-18 Jan).

This ongoing enhancement is supported in MOSWOC Enlil output, although this is perhaps over-estimating the longevity of the feature.

Overall Quiet to Unsettled conditions are expected with a chance of Active intervals on all days. There is a slight chance of reaching a G1 Minor Storm interval, perhaps slightly higher though days 2-3 (17-18 Jan).

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	10	10	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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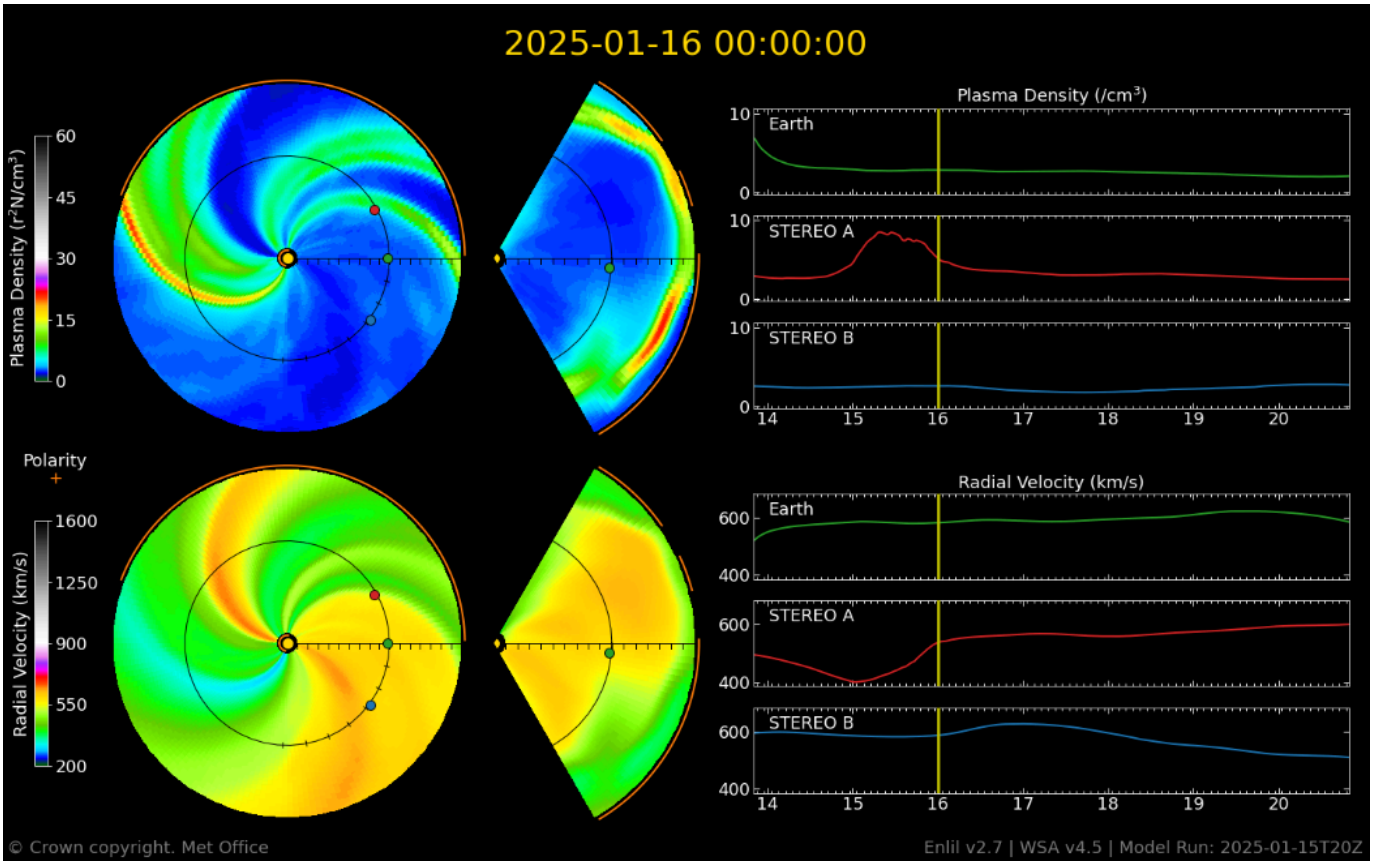
Figure 2: Latest MOSWOC ENLIL output.



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Radio Blackouts - X-Ray Flares

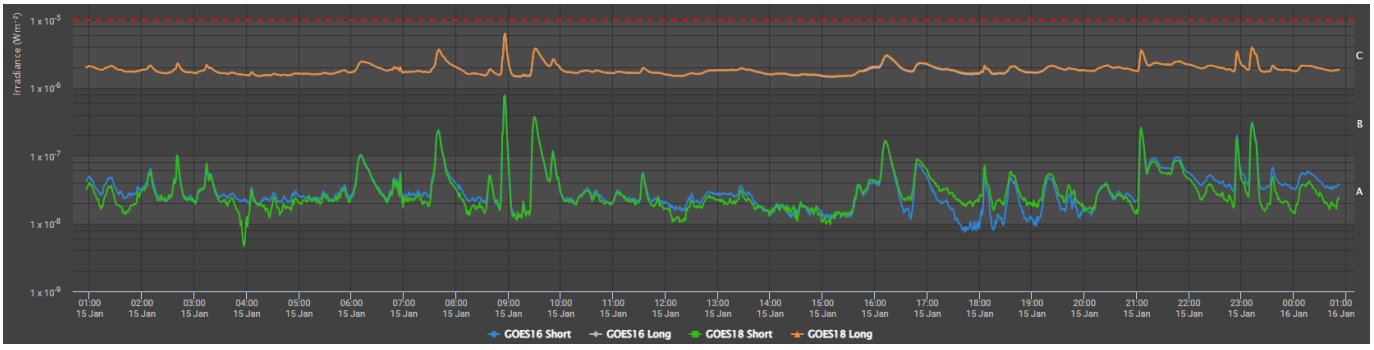
The most likely flare sources are currently in the eastern hemisphere, including the large AR3959. This region has so been fairly inactive and primarily comprised of a large leader spot, but the development of a small trailer continues to suggest some complexity and potential for growth. AR3961, in the southeast has been the most active region in recent hours. This region while currently appearing to be a relatively simple bipolar group it has seen the emergence of intermediate spots as it rotates to a less oblique viewing angle.

Further complexity is also possible from AR3962 as it rotates into a clearer view. The other regions remain smaller and simpler, however further activity cannot be completely ruled out from over the eastern limb with far-side Helioseismology and sunspot recurrence suggesting the likelihood of further active regions rounding the limb into the period

Generally Low to Moderate activity is currently expected to continue, with an increasing likelihood of isolated M-class flares though the period, chiefly from regions rounding the eastern limb.

X-Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 (M Class)	No	40	50	60	60
Very Active	R3-R5 (X Class)	No	5	5	5	5

Figure 3: GOES16/18 24hr X-Ray trace.



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Solar Radiation Storms (High Energy Protons)

GOES18 high energy proton flux has remained at background over the last 24 hours and is expected to persist at this level. The main complexity on the disc is currently on the eastern disc, which is a less likely source location for proton events to be observed at Earth.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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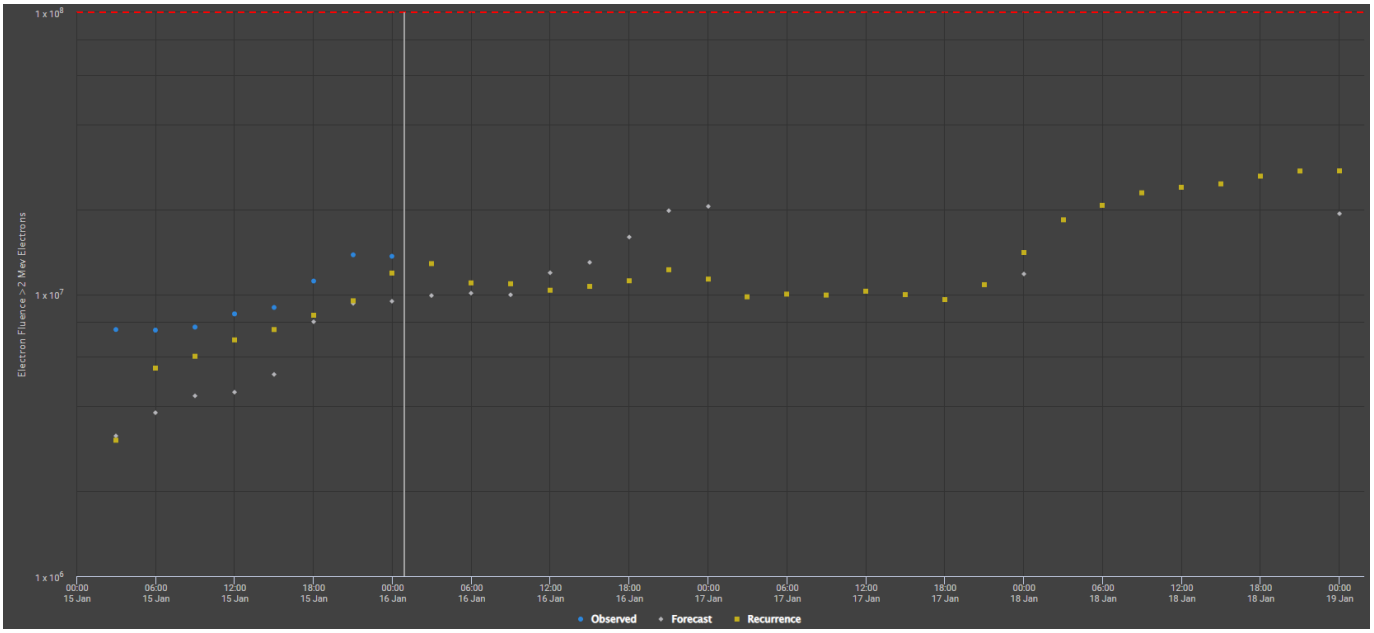
High Energy Electrons (≥ 2MeV)

High energy electron flux observed at GOES16 has been at normal to moderate levels during the past 24 hours. Ongoing coronal hole influences are likely to likely to lead to some charging of the Van Allen belts, but potentially result in the majority of this charge persisting below GEO. Ongoing periods of Moderate flux are likely at diurnal peak, perhaps approaching High at times.

Overall, fluence is forecast to remain below Active, but may see a rising trend during the period. This is hinted at with REFM and 27-day Recurrence.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	5	10
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 4: Latest MOSWOC REFM output.



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